DOCUMENT RESUME

ED 380 126 IR 055 429

AUTHOR Gregg, Joe; Persichitte, Kay
TITLE Considerations for the Optimal Design of a Two-Way Interactive Distance Education Classroom.
INSTITUTION University of Northern Colorado, Greeley. Western Inst. for Distance Education.
PUB DATE Jan 92
NOTE 22p.
PUB TYPE Reports - Evaluative/Feasibility (142)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Audiovisual Aids; *Classroom Design; Computer Assisted Instruction; Computer Mediated Communication; *Cost Estimates; *Design Requirements; *Distance Education; Educational Facilities Design; Educational Technology; Higher Education; *Interactive Television; Nontraditional Education; Teaching Methods; *Telecommunications

ABSTRACT

To make effective use of a two-way interactive distance education system, classroom design should be a primary consideration. A properly designed classroom will enhance content objectives and increase acceptance of this type of instructional delivery. This paper describes key considerations for optimal design. Construction considerations include those of electric service, temperature control, access for telecommunications equipment, and location. Classroom dimensions and configuration must be considered with regard to course content, instructional style, the number of students at the site, and the hardware to be used. Interior design must suit the needs of student, instructor, and technology. The greatest obstacle to optimal distance education classroom design is audio difficulty, since sound quality is the component that frequently fails to meet expectations. Lighting is another consideration that can not be neglected. A general estimate is given for costs for remodeling an existing classroom. Sample hardware component specifications are listed. Three figures illustrate the discussion. (Contains 6 references.) (SLD)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED 380 126

WESTERN INSTITUTE FOR DISTANCE EDUCATION
UNIVERSITY OF NORTHERN COLORADO

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

Considerations for the Optimal Design of a Two-Way Interactive Distance Education Classroom

Prepared by

Joe Gregg
Kay Persichitte

January 1992

IR055429

BEST COPY AVAILABLE

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Edward Caffarella
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Considerations for Optimal Design of a Two-Way Interactive Distance Education Classroom

In order to make the most effective use of a two-way interactive distance education delivery system, classroom design should be a primary consideration. Visit with anyone who has history in education and you will hear the stories of how poor implementation of technology contributed to its ineffectiveness. Technical aspects of contemporary telecommunication technologies present special challenges. A properly designed classroom will enhance content objectives and increase acceptance of this type of instructional delivery within student and faculty user groups (Price, 1991).

This paper will describe key considerations for optimal design within several areas: construction considerations, classroom dimensions, classroom configurations, interior design guidelines, acoustics guidelines, lighting guidelines and hardware components. Considerations of cost must be included in the actual design process, but are addressed in this paper only as they reflect the current direction of the WIDE project.

Construction Considerations

Whether the classroom is to be a ground-up construction project or is to be a re-model of an existing classroom, the following considerations are important. While it may not be possible to meet the optimal standard in every consideration, remember that these are inter-related criteria and poor application in one area may well be reflected elsewhere.

Electric Service

The hardware system cable structures are sensitive to electro-magnetic fields, heat, vibrations, surges, and spikes. Thus, the classroom wiring system should not be located near compressor motors, blower motors, elevator motors, heating, ventilating or air conditioning systems/wiring structures (Cogliano, 1991).

For maximum effectiveness and minimal system failure, consider inner liners or separate conduit for each connection. Protect electrical services by installing surge/spike protectors. The best option is to service these classrooms through a set of dedicated circuits with the breaker panel installed in the classroom and clearly labeled as to the control function of each breaker. Provide for future increases in the need for electrical service by including additional capacity in the breaker panel (Allen, R.L., 1991).

When complete, these classrooms will have complex networks of wiring that may or may not be connected to permanently fixed structures. Maximum flexibility in use is permitted with the installation of a wooden sub-floor that allows access to floor wiring structures for up-date or repair purposes. Sub-flooring also allows for the installation of outlets on the floor as well as on the walls. Access to ceiling wiring should be through suspended ceilings (further discussion within Interior Design Guidelines). Electrical service is a complicated problem that requires careful forethought and competent installation.

Ventilation/Temperature Control

All of the equipment associated with the delivery of distance education generates heat. While it is necessary to have an HVAC

BEST COPY AVAILABLE

system in support of this equipment, the circulation of air should not be achieved at the expense of controlling a) the background noise of the HVAC system or b) the effective usage of the delivery system. Options to consider are diffusers and acoustically lined duct-work.

Each classroom should have a temperature-sensitive monitoring device within it. Temperature should be maintained near 70 degrees and humidity at 40 to 60 percent (Allen, R.L., 1991).

Telecommunications

Telephone wiring should be included and should consider future provisions for increased voice, data and video transmissions. Multiple phone jacks should be accessible in various classroom locations.

Location

To improve acoustic weaknesses, choose locations in a quiet area of the building (Carl & Densmore, 1988). Best effort should be made to stay away from restrooms, vending machines, lobbies, plaza areas and elevators. If possible, locate the classroom near a media center. Doors should be of solid construction and equipped with weather stripping and floor sweeps (Price, 1991). Doors should be situated to be outside camera view range; usually at the back of the classroom. Windows should be avoided, if possible (further discussion within Interior Design Guidelines). Finally, these classrooms are major investments and represent complex instructional environments that may require specialized security arrangements.

Classroom Dimensions

Most 2-way interactive classrooms are designed for 12 to 20 students, but these dimensions may be altered to adapt to larger student groups if the hardware specifications are manageable. Generally, the classroom length should be one and one-half times the width. Rectangular shapes are more conducive to viewing angles and acoustics than are square shapes. Allow approximately 30 square feet per learner (Carl & Densmore, 1988). Recommended ceiling height is 12 feet (Allen, M., 1991).

Classroom Configurations

Classroom configuration needs to consider the content to be offered, the prevalent instructional style, the number of learners, and the hardware that is to be used. Regarding monitor selection, a general rule of thumb is one viewer per diagonal inch of monitor; e.g. a 20-inch monitor can serve at most 20 viewers. The maximum viewing distance is usually twelve times the monitor screen width. The minimal viewing distance is between four and seven feet (Price, 1991). Ideally, learners should be allowed to find their personal preferred viewing location. Monitors should be mounted so that the viewer angle is no more than 30 degrees. Monitors should not be placed in corners. Not only does corner-mounting create awkward viewing angles, it also diminishes the importance of the visual presentation. Particular attention should be paid to the safety issues involved with mounting monitors on walls or overhead.

Figure 1 is a sample configuration for a classroom strictly dedicated to lecture style presentation. This represents the design

most frequently used in interactive telecommunications classrooms. Class size is restricted only by physical room size and hardware capabilities.

Figure 2 is a sample configuration for a classroom dedicated to a flexible presentation style. Lecture, cooperative grouping, conferencing or large group facilitation are possible within the confines of class sizes of 20 or less. This is the basic configuration recommended for WIDE instructional applications.

Figure 3 is a sample configuration for conference room applications or class sizes of 10 or less. It is our recommendation that WIDE maintain a conference design as well as a classroom for flexible presentation purposes.

Interior Design Guidelines

Research in distance education indicates that appropriate aesthetic and functional qualities of the classroom contribute to favorable learner attitudes (Price, 1991). Distance education classrooms are particularly susceptible to poor audio and video aspects of instruction (Cogliano, 1991).

Windows/Walls

If the classroom design includes windows, they should be covered with drapes equipped with cord tighteners. The drapes offer some control over light and acoustic problems. The window coverings and walls should be mid-spectrum colors, e.g. tans, light blues or grays, to allow easy justification of the CODEC (Carl & Densmore, 1988; Price, 1991; Cogliano, 1991). The color "Jennifer Blue" has been found to be particularly effective (Cogliano, 1991).

Trim colors should be light to medium tones. The color white and obvious patterns should be avoided. Non-glare surface finishes are a necessity due to concerns for reducing glare and reflection onto monitor screens. Shiny plastics, glass and chrome finishes should be avoided. Reflectance values for paint can be found in samples and selection charts (Allen, R.L., 1991). If severe audio difficulties are anticipated, consider cloth walls or adding sound soak to existing walls (Allen, M., 1991).

Floors/Ceilings

Maximum audio application is facilitated by carpeting floors. Floors should be smooth and free of wiring and cords. Floor color should be light to medium and should contain some type of subdued pattern or fleck. Ceilings should be light colored and made of non-reflective materials.

Furnishings

To account for the differences in learner expectation in a telecommunications classroom, special consideration should be given to individual comfort. Attention should be paid to adequate work space and comfortable seating. At a minimum, learners require a 20-inch deep surface area at which to work (Price, 1991). Individual, cushioned, moveable chairs provide a major, positive, critical attribute of optimal distance education classrooms. Upholstery should meet previous color guidelines, be non-reflective, and, hopefully, be aesthetically pleasing.

Storage

Each classroom should provide an adequate and secure storage area for peripheral instructional equipment, as well as materials needed on a repeated basis (Allen, R.L., 1991).

Instructor Area

The instructor area should be designed to accommodate the hardware controls which the instructor will need to access within the lectern. Consider designing the instructor area as a slightly raised area complete with proper lighting and acoustics. Easy access to remote control devices, switching mechanisms and the presentation stand are essential. An adjustable, cushioned stool should be available. The instructor should be able to view all off-site monitors on the same line of sight that the instructor camera is set on. Blackboards and whiteboards do not emit quality video transfer, and should not be included in 2-way telecommunications classrooms.

Private Conference Area

These classrooms are not particularly conducive to individualized student/teacher contact. For this reason, it is recommended that a corner of the classroom be partitioned off to create a small, private conference area that will allow the instructor the ability to have a private conference with a remote site student. This area needs to be equipped with a camera, small monitor, and headset.

Acoustics Guidelines

The greatest obstacle to optimal distance education classroom design is audio difficulties. Instructors and learners alike, most often

report that the sound quality is the component which least meets expectations. The goals of optimal acoustic design are to limit interior and exterior noise, and to control echoes (Price, 1991). Some mention has been given regarding these goals in previous sections of this paper, but there are additional considerations.

Plaster walls, tile floors and tile ceilings create constant echo (Cogliano, 1991). Walls and floors should be sound resistant and constructed of dense material. Walls should extend above suspended ceilings to the roof or floor structure above (Price, 1991). Acoustical quality will be improved with non-parallel walls. Ceilings should be suspended and made of acoustical tiles. Contemporary CODECs generally include an automatic adjustment for acoustics, but it is not advisable to rely on this technology alone. Similarly, various electronic echo-suppressing systems are available, but they have received mixed ratings. Echo-cancelling systems are effective for dealing with acoustics concerns and should be included. Tabletop microphones, suspended PZM microphones or angled shotgun microphones are recommended for the learners and a wireless lavaliere microphone is recommended for the instructor. Microphone feedback and coverage area are key considerations in this decision. Attention to these details as well as the hardware specifications noted within the section titled Hardware Component Specifications compound the probability of quality audio transmission.

Lighting Guidelines

Control of lighting is an important consideration within telecommunications classrooms. Good lighting designs allow fixtures

to be selectively switched off or dimmed. Halogen lamps are good light sources, but more expensive than a combination of fluorescent and incandescent fixtures. This type of lighting combination allows a more pleasing balance of color and reduces flicker phenomena on monitor screens. Provisions should be made for a highly concentrated light source at the instructor lectern. Avoid unshielded light surfaces and natural light. Overhead lighting is best for students; horizontal lighting is best for cameras (Hudspeth & Brey, 1986). Indirect student lighting can be accomplished using fixtures which reflect the light source back to the ceiling instead of down upon the student work areas. An alternative is to install diffusers or baffles (usually at 45 degrees) on the existing fixtures (Cogliano, 1991). Cool white lights enhance visual comfort; recommended levels are 30 to 100 footcandles. Light levels at the remote sites need only be high enough to provide a good out-going camera image. Over lighting at remote sites is common.

Conclusion

By now it should be obvious that the complexity of the variables within the physical environment of a telecommunications classroom requires tremendous planning and attention to the inter-related characteristics of these variables if the design is to meet the needs of the learner in a non-traditional classroom setting.

Cost

A very general cost estimate for the complete re-model of an existing classroom into a flexible presentation telecommunications classroom, which takes into consideration the bulk of the issues discussed here, is $20,000. It should be noted that this amount might be reduced based on the re-model specs being put out to bid.

Specific furnishings costs can be estimated as follows:

student chairs (20 @ $250.00)	$5000.00
instructor stool	$ 250.00
student tables (7 @ $56.00)	$ 392.00
instructor work table	$ 70.00
total estimate	$5712.00

Currently, there is a definite need to replace chairs in the existing conference room. This cost is (10 chairs @ $300.00) estimated to be $3,000.00.

Hardware Component Specifications

Assumptions:

1) All cost estimates are for equipment not installation. The CODEC and PC costs are not included in this estimate.
2) Hardware should generate a video signal that meets television broadcast specifications.
3) Hardware should allow room reconfiguration for:
   a) lecture style presentation
   b) flexible presentation
   c) conferencing

Monitors

-Color monitor: 25" minimum, 30" maximum.

-Minimum 2 video inputs, with one BNC input/loop output BNC.

-RBG input compatible with CGA and EGA graphics.

-8-pin VTR input.

-Sync input.

-Dual channel, RCA audio input with stereo amplifier and stereo speakers.

-External speaker output terminals.

-Full range color controls: color, tint, black-level, picture, sharpness, RGB contrast, RGB H-position, and blue raster switch.

-560 line horizontal resolution, minimum; 600 line horizontal resolution, maximum.

Camera, Tripod, and Remote Control Tilt/Pan Tripod Head

-1/2" interline-transfer, 3 CCD color camera.

-2/3" lens mount adaptor.

-Canon 8.0mm-100mm, teleconferencing lens with remote control servo.

-Remote control for Canon lens.

-Minimum 50 dB signal-to-noise ratio.

-Minimum 500 lines TV resolution.

-Light sensitivity at f5.6, 2000 lux.

-Auto white and black balance.

-Built in color bar generator.

-Color temperature conversion filters.

-Multi-pin and BNC video output.

-Camera AC mount adaptor with multi-pin connection.

-Multi-pin cable.

-Large-format tripod with heavy-duty head and tripod adaptor.

Microphones, Audio Mixer, & Echo Cancelling System

-Modular microphone system with power module. Supercardioid and short shotgun heads. 3-position bass rolloff switch. All microphone heads with frequency range 50-15,000Hz.

-Wireless microphone system. Diversity receiver, body-pack transmitter and unidirectional lavalier microphone.

-4 channel low-impedence audio mixer with balanced input, switchable to mic or line level. Mic and line outputs. Master output volume control.

-PZM microphones for conference configuration.

-Full range Echo Cancelling Audio System

Presentation Stand

-Presentation stand with CCD camera. 370 lines resolution.

Computer and Peripheral Equipment

-386 microcomputer

-PODIUM software

-Laser printer

Configuration (Figures 2 & 2A):

-Two color monitors on movable video carts at the front of the room.

-Two color monitors on fixed wall mounts at the back of the room.

-VCR and laserdisc on video cart at the front of the room.

-Three microphones attached to fixed ceiling mounts with flexible gooseneck shafts. Microphones are connected to the audio mixer located at the front of the room.

-Wireless receiver connected either to the audio mixer or CODEC.

-Three PZM microphones are available for use in the conference configuration (Figure 3).

-One camera with remote control zoom lens on a movable tripod with remote control pan/tilt drive at the front of the room.

-One camera with remote control zoom lens on a movable tripod at the back of the room.

-Presentation stand, PC computer, and peripheral equipment are located near the instructor's podium at the front of the room.

-Computer printer and FAX machine are located at the front of the

room.

-CODEC, wireless receiver and audio mixer are located at the front of the room.

-A private conference area for personal communication between sites is located at the back of the room.

Budget

Color Monitors	4 @ $1,500	$ 6,000.00
Small Monitor	1 @ $ 350	$ 350.00
Wall Mounts	2 @ $ 200	$ 400.00
Video Table	2 @ $ 200	$ 400.00
3-CCD Camera	2 @ $8,500	$17,000.00
1-CDD Camera	1 @ $ 750	$ 750.00
Tripod	2 @ $ 400	$ 800.00
Pan/Tilt Drive	1 @ $1,400	$ 1,400.00
Video Cable		$ 400.00
Microphones-modular	1 @ $ 700	$ 700.00
Wireless Mic System	1 @ $ 620	$ 620.00
PZM Mics	3 @ $ 200	$ 600.00
Echo Cancelling System	1 @ $ 7,500	$ 7,500.00
Headset	1 @ $ 150	$ 150.00
Audio Cable		$ 300.00
Ceiling Mount		$ 100.00
386 Microcomputer	1 @ $2,500	$ 2,500.00
PODIUM software	1 @ $ 500	$ 500.00
Computer Printer	1 @ $1,000	$ 1,000.00
Presentation Stand	1 @ $3,100	$ 3,100.00
VCR	1 @ $ 250	$ 250.00
Laserdisc Player	1 @ $ 800	$ 800.00
FAX/laser printer	1 @ $1,800	$ 1,800.00
Telephone	1 @ $ 75	$ 75.00
(does not include monthly service charge)		
	Sub Total:	$ 47,445.00
	40% discount*	$<19,000.00>
	TOTAL	$ 28,445.00

*These are catalog list prices. For an equipment package of this size, most bids should reflect more than a 40% discount of the list price.

References

Allen, Marshall. (1991, September). [Interview with Marshall Allen of Oklahoma State University].

Allen, Robert L. (1991). Design of General-Purpose Classrooms and Lecture Halls. (Available from Penn State University-wide Classroom Improvements Committee 206 Special Services Building University Park, PA 16802).

Carl, Diana R., & Densmore, Bruce. (1988). Distance university education via television (DUET). Canadian Journal of Educational Communication, 17(2), 81-94.

Cogliano, Steve. (1991, September). [Interview with Steve Cogliano of Plexus, Inc.].

Hudspeth, DeLayne R., & Brey, Ronald G. (1986). Instructional Telecommunications: Principles and Applications. New York: Praeger.

Price, Michael A. (1991, January). Designing video classrooms. Instructional Technology, pp.15-19.

Figure 1

Dedicated Lecture Style Configuration

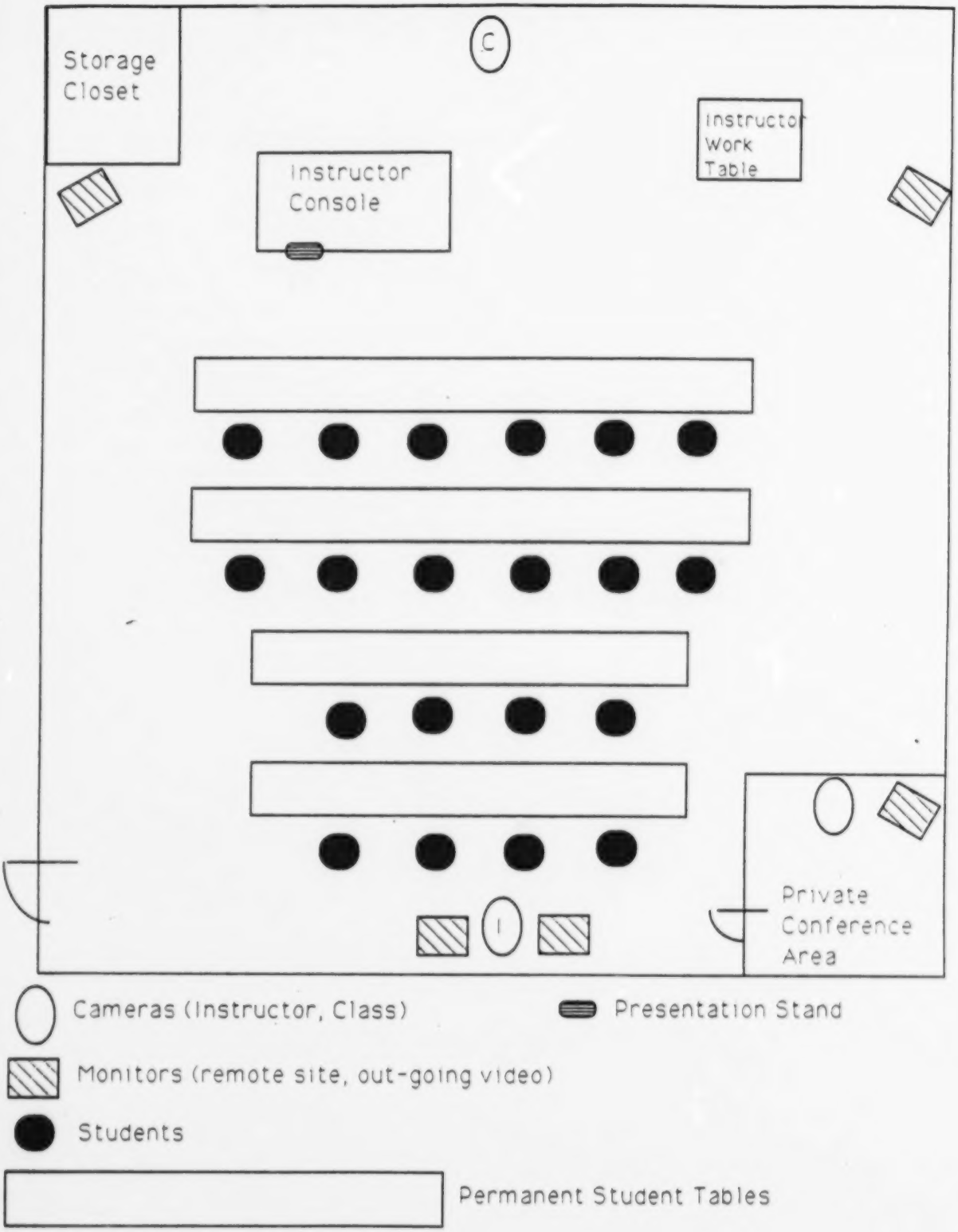


Figure 2

Flexible Presentation Configuration

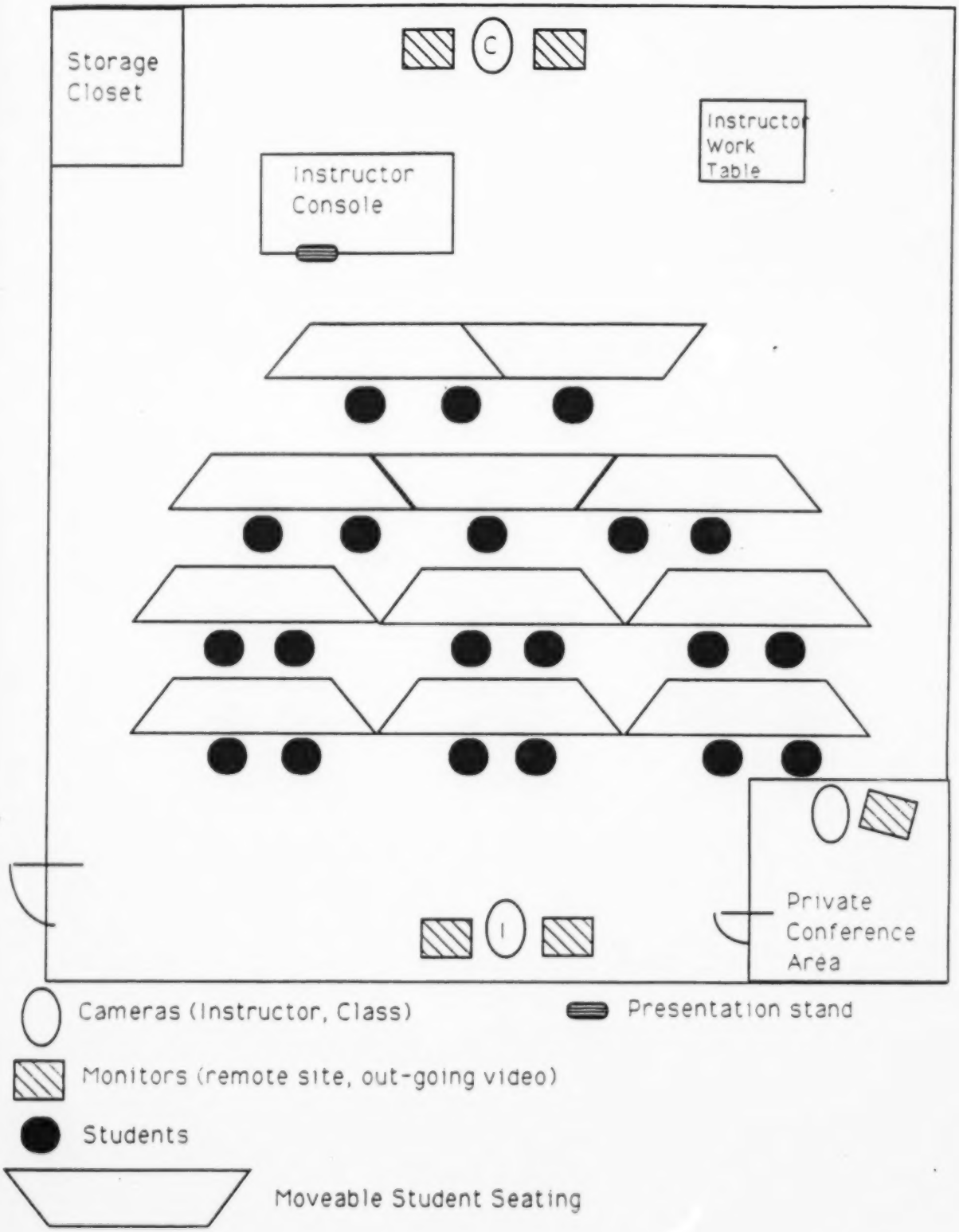
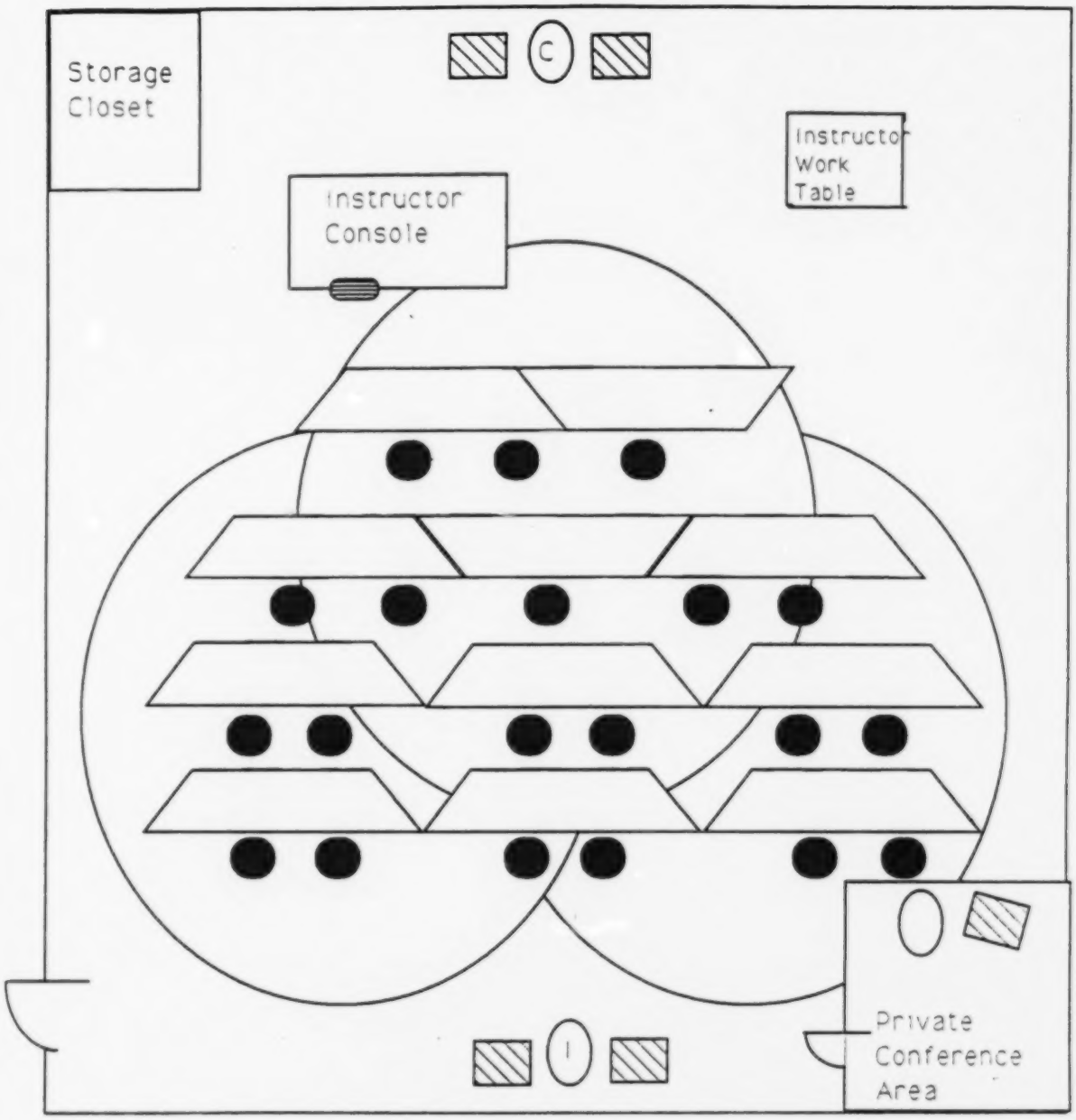


Figure 2A

Flexible Presentation Configuration



Ellipses represent microphone pick-up patterns for overhead microphone placement (3 microphones)

Figure 3

Dedicated Conference Configuration